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Maximizing the Benefit of Early-Stage CFD Ventilation Analyses to Reduce Fire and Explosion Hazards

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Abstract

One of the most significant hazards faced by offshore platforms, FLNGs, and chemical facilities is the risk of explosions resulting from the ignition of flammable clouds due to an unintentional release (leak). Natural ventilation can act as a passive safety measure by helping to dilute and disperse released gases to levels below their flammable limits. Computational fluid dynamics (CFD) ventilation studies are often performed to validate that layouts meet industry criteria or as a step in more complex safety studies; however, often these studies occur during later phases of design after it is "too late" to make basic changes that can drastically alter the risk posed by toxic, fire, and explosion hazards.

Many ventilation studies provide results as a single measure, such as "adequate ventilation" measured by the number of air changes per hour (ACH) for a given area. For example, certain hazardous area classifications require that the ventilation must be greater than 12 ACH at least 95% percent of the time (95th percentile ACH). However, the 95th percentile ACH only describes a limited range of the ventilation conditions at the facility and should not be used as the sole means of comparing alternative layouts or making design decisions.

A carefully constructed ventilation study that accounts for the nature of facility hazards can provide relatively fast and inexpensive insight into potential safety-oriented optimizations during early stages of facility design. By providing this insight early in design, facilities can be rigorously designed for safety—minimizing the risk (and therefore cost) of late-stage design changes. This paper will present guidance on some of the requirements for and benefits of early-stage ventilation studies. The paper will use specific examples derived from recent work in prioritizing safety in early-stages of design to demonstrate the value of such studies and why the industry needs to move beyond focusing on just the 95th percentile ACH.